

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the US Patent Application of

Junichi SATO

Serial No. 09/161,520

Filed: September 29, 1998

For: CHEMICAL-MECHANICAL
POLISHING PROCESS

Group Art Unit: 1763

Examiner: A. POWELL

SUPPLEMENTAL APPEAL BRIEF UNDER 37 C.F.R.
§§ 1.192 AND 1.193(b)(2)(ii)

H19
41510
MV

Sir:

This is a Supplemental Appeal Brief under 37 C.F.R. §§ 1.192 and 1.193(b)(2)(ii) requesting reinstatement of the Appeal in response to the non-final rejection of the Examiner dated November 30, 2000 (Paper No. 16). Accordingly, reinstatement of the Appeal is respectfully requested. Each of the topics required by 37 C.F.R. § 1.192 is presented in this Brief and is labeled appropriately.

I. Real Party in Interest

Sony Corporation of Tokyo, Japan ("Sony") is the real party in interest of the present application. An assignment of all rights in the present application to Sony was executed by the inventors and recorded by the U.S. Patent and Trademark Office at reel 9510, frame 0496.

II. Related Appeals and Interferences

There are no appeals or interferences related to the present application of which the Appellant is aware.

III. Status of Claims

On July 28, 2000, Appellant appealed from the final rejection of claims 12 to 14, and 16 to 27. The application as filed on September 29, 1998 originally included claims 12 to 14, and 16 to 20. No claims were withdrawn from consideration pursuant to a restriction requirement. Claim 21 was added on February 23, 1999. Claims 12 and 16 were amended and claims 22 to 27 were added on June 24, 1999. Claim 23 is canceled, and incorporated verbatim into claim 22 in an amendment accompanying this paper.

Claims 12 to 14, 16 to 22, 25, and 27 are the subjects of this appeal, as claims 24 and 26 have been considered to be allowable by the Examiner.

IV. Status of Amendments

Following the issuance of the final rejection in Paper No. 9, Appellant filed a Response After Final Rejection on June 28, 2000 making no changes to the claims. In an Advisory Action mailed on June 27, 2000 the Examiner maintained the

rejections set forth in Paper No. 9. Appellant filed a Notice of Appeal on July 28, 2000, and an Appeal Brief was filed September 27, 2000.

The Examiner reopened prosecution of the application, issuing Paper No. 16 on November 16, 2000. However, the Examiner did not cite a new ground of rejection in compliance with 37 C.F.R. § 1.193 or M.P.E.P. § 1208.01. Instead, Paper No. 16 merely withdrew rejections of two of the pending claims, and reformulated the previous rejections only using previously cited prior art. This Brief is filed to have the appeal reinstated. The claims in the Appendix represent the state of the claims at the date of filing the Notice of Appeal.

V. Summary of the Invention

The first embodiment of the present invention is a chemical-mechanical polishing process for planarizing one or more thin films such as an interlayer dielectric film (104 in Fig. 1A) formed on a substrate (5 in Fig. 3) such as a semiconductor wafer. The chemical-mechanical polishing process is performed using a slurry that contains abrasive particles including boehmite in a basic atmosphere (page 13, lines 11 to 15). While boehmite particles are used according

to this embodiment of the invention, it is within the general scope of the invention to use a basic slurry containing abrasive particles that are made of a material higher in hardness than SiO_2 . The boehmite particles in the slurry are preferably suspended in a solution containing KOH, water, and an alcohol (page 13, lines 11 to 15). According to the first embodiment, the particles of boehmite are formed by dipping particles of Al in hot water (page 13, lines 15 to 17). In addition, it is advantageous to add sodium aluminate to the hot water (page 13, lines 16 to 17). The hot water is typically about 80 °C (page 13, lines 16 to 17).

The second embodiment of the invention is a chemical-mechanical polishing process as set forth in the first embodiment, further including the step of removing any residual slurry and contamination by spin cleaning. The spin cleaning is performed using chemicals that include a solution containing NH_4 , H_2O_2 , and H_2O (page 13, lines 20 to 23). Following this step, a hydrofluoric acid solution is applied to the thus cleaned surface (page 13, line 23 to page 14, line 1). Finally, the substrate surface is rinsed with pure water (page 14, lines 1 to 2).

VI. References of Record

In the rejection of Paper No. 16, the Examiner relied upon the following prior art:

- (1) U.S. Patent No. 5,693,239, issued to Wang et al.
("Wang");
- (2) U.S. Patent No. 5,445,807, issued to Pearson
("Pearson"); and
- (3) U.S. Patent No. 5,723,019, issued to Krussell et al.
("Krussell").

VII. Issues

In light of the rejection in Paper No. 16, the issues presented on this appeal are:

- (1) whether claims 12 and 21 are anticipated, as these claims stand rejected under 35 U.S.C. § 102(e) as being anticipated by Wang;
- (2) whether claims 13 to 14, 22 to 23, and 27 are obvious, as these claims stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Wang in view of Pearson;
- (3) whether claims 16 to 20, and 25 are obvious, as these claims stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Wang in view of Pearson and Krussell.

VIII. Grouping of Claims

Claims 12 and 21 stand or fall together. Claims 16 to 18 stand or fall together. Claims 14, 20, 22 and 27 stand or fall together. Each of claims 13, 19, and 25 stands or falls alone. The reasoning for the grouping of the claims is evident in light of the following arguments.

IX. Arguments

A. Rejections Under 35 U.S.C. § 102(e)

As basis for the rejection of claims 12 and 21, the Examiner asserts that Wang discloses polishing a work piece by applying an aqueous slurry comprising water, submicron particles such as boehmite, and an oxidizing agent. Claims 12 and 21 are independent claims, and the reasons that rejecting these claims as anticipated by Wang are separately discussed below.

Independent claims 12 and 21 iterate that the polishing is performed in a basic atmosphere. The instant specification, in Example 3, discloses that the slurry is suspended in a solution of potassium hydroxide, water, and another alcohol. In contrast, the slurries prepared according to the Wang disclosure are acidic suspensions. At column 3, lines 55 to 62, Wang discloses that compounds such as potassium hydrogen

phthalate and ammonium hydrogen phthalate are included in the slurries. These compounds have at least two acid groups, and the pK_a of the first dissociable acid is not substantially larger than the pH of the polishing slurry composition. Accordingly, Wang teaches away from polishing in a basic atmosphere.

In section 7 of Paper No. 16, the Examiner asserts that Wang teaches the use of oxidizing agents as well as the above phthalate compounds. The Examiner then concludes that Wang teaches both an acidic and basic atmosphere. This is incorrect.

Wang teaches the use of the phthalate compounds together with oxidizing agents (col. 3, lines 46 to 53). However, the key point is Wang's teaching that the phthalate compounds have at least two acid groups, and the pK_a of the first dissociable acid is not substantially larger than the pH of the polishing slurry composition (col. 3, lines 55 to 62). The phthalate compounds, and the method of using them, are referred to by Wang as falling within the scope of U.S. Patent No. 5,391,258, issued to Brancaleoni et al. ("Brancaleoni"). A copy of the Brancaleoni patent is included with this paper as Appendix B.

Brancaleoni teaches that whenever phthalates are used in a polishing process, the pH of the polishing slurry is very

acidic even when oxidizing agents are applied to the slurry. Furthermore, the pK_{a1} of phthalic acid is 2.95 (col. 4, line 46). Examples 1 and 3 give examples of polishing compounds using phthalate compounds, and in every case the pH of the solution is much less than 7. Because Wang teaches use of phthalate compounds in a polishing slurry as taught by Brancaleoni, and Brancaleoni only teaches the use of slurries in an acidic environment, Wang fails to teach or suggest that the polishing is performed in a basic atmosphere.

The Examiner seems to be concluding in section 7 of Paper No. 16 that an oxidizing agent only works in a basic atmosphere. This is incorrect. Consequently, Wang does not inherently teach a basic atmosphere. Furthermore, Wang does not explicitly teach planarization in a basic atmosphere. In fact, for the above reasons, Wang tends to teach away from such a teaching.

"A claim is anticipated [under 35 U.S.C. § 102(e)] only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." Verdegaal Bros. v. Union Oil Co. of California, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987) (emphasis added). See M.P.E.P. § 2131. Because Wang does not disclose polishing in a basic atmosphere, each and every limitation in

independent claims 12 and 21 is not taught or suggested by Wang, and the rejection of claims 12 and 21 under 35 U.S.C. § 102(e) should not be sustained by the Board.

B. Rejections Under 35 U.S.C. § 103(a)

The differences between Wang and independent claims 12 and 21 set forth above are incorporated herein by reference to avoid unnecessary repetition. In light of these differences, each and every limitation of claims 13 to 14, 16 to 20 is not provided by Wang, and the rejection of these claims should be withdrawn. "To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974)." M.P.E.P. § 2143.03. Accord. M.P.E.P. § 706.02(j). It is pointed out that neither Krussel nor Pearson provide a teaching or suggestion of polishing in a basic atmosphere, or the claimed step of forming the boehmite slurry by dipping aluminum in hot water. Krussel is directed to a process for cleaning a wafer, and is not directed to a polishing method. Pearson is directed to formation of aluminum compounds, but not the use of such compounds in a polishing step, and thus makes no mention of polishing in a basic atmosphere. Accordingly, the deficiencies of Wang are

not provided for by either of the secondary reference, and the obviousness rejections of the claims should not be sustained.

Further, independent claim 16 includes the limitation that the abrasive particles in the slurry consist essentially of boehmite. Neither Pearson nor Krusell discloses the claimed slurry consisting essentially of boehmite. Wang discloses slurries that contain boehmite particles, but the Wang slurries do not contain abrasive particles that consist essentially of boehmite. Rather, Wang slurries include submicron alpha-alumina particles as an essential and inventive component, in addition to substantially less abrasive particles that may include aluminum oxide materials such as boehmite.

The Examiner asserts in section 8 of Paper No. 16 that additional abrasive particles within the slurry would not materially change the characteristic of the present invention. Yet, to take a slurry that is essentially boehmite, and then to add alpha-alumina, which is substantially more abrasive than boehmite, would intuitively change the slurry to become substantially more abrasive. It is clear that making the slurry substantially more abrasive would change the slurry in a material manner. Consequently, the Wang slurry does not consist essentially of boehmite as claimed in claim 16.

Accordingly, the "consisting essentially of" limitation of claims 16 to 20 is not taught or suggested by any of the prior art references of record, and the rejection of claims 16 to 20 under 35 U.S.C. § 103(a) should be withdrawn.

Claims 14, 20, and 22 include the limitation that the hot water in which the aluminum is dipped to form boehmite includes sodium aluminate. The Examiner asserts that Pearson discloses "an aluminum product" at column 3, lines 10 to 22, and that aluminum product suggests sodium aluminate. To the contrary, Pearson proposes that the aluminum product is gibbsite, which is a mineral form of hydrated $\text{Al}(\text{OH})_3$. It is highly suspicious of a hindsight analysis to assert that the mere assertion of aluminum suggests one specific aluminum containing product that happens to be claimed in the present application.

The Examiner has failed to state how a person of ordinary skill in the art of polishing semiconductor wafer layers would be motivated to form boehmite by dipping aluminum in water combined with sodium aluminate from Pearson's disclosure of forming boehmite using water combined with an aluminum product such as gibbsite. Because such motivation is not taught or suggested by Pearson in combination with Wang and Krussell,

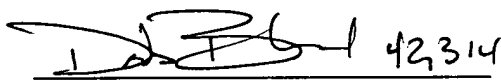
the rejections of claims 13 to 14, 22 to 23, and 27 should not be sustained.

X. Conclusion

In view of the foregoing, it is submitted that the final rejection of claims 12 to 14, and 16 to 27 is improper and should not be sustained. Therefore, a reversal of the Final Rejection in Paper No. 9 is respectfully requested.

Respectfully submitted,

DATE: March 30, 2001


Ronald P. Kananen
Registration No. 24,104

RADER, FISHMAN & GRAUER PLLC
Lion Building
1233 20th Street, N.W.
Washington, D.C. 20036
Tel: (202) 955-3750
Fax: (202) 955-3751

APPENDIX AClaims on Appeal

12. A chemical-mechanical polishing process for planarizing one or more thin films formed on a substrate, wherein the chemical-mechanical polishing is performed using a slurry containing abrasive particles containing boehmite in a basic atmosphere.

13. A chemical-mechanical polishing process according to claim 12, wherein the particles of boehmite are formed by dipping of particles of Al in hot water.

14. A chemical-mechanical polishing process according to claim 13, wherein said hot water is added with sodium aluminate.

16. A chemical-mechanical polishing process for planarizing one or more films formed on a substrate, wherein said thin films are subjected to chemical-mechanical polishing using a slurry containing abrasive particles consisting essentially of boehmite, and the residual slurry and contamination are removed by spin cleaning.

17. A chemical-mechanical polishing process according to claim 16, wherein said spin cleaning is performed using chemicals comprising a solution containing NH_4OH , H_2O_2 , and H_2O , followed by a hydrofluoric acid solution.

18. A chemical-mechanical polishing process according to claim 17, wherein after spin cleaning using said chemicals, said substrate is rinsed with pure water.

19. A chemical-mechanical polishing process according to claim 16, wherein the abrasive particles of boehmite are formed by dipping of particles of Al in a hot water.

20. A chemical-mechanical polishing process according to claim 19, wherein said hot water is added with sodium aluminate.

21. A chemical-mechanical polishing process for planarizing one or more of thin films formed on a substrate, wherein said chemical-mechanical polishing is performed using a basic slurry containing abrasive particles made of a material higher in hardness than SiO_2 .

22. A polishing process which comprises the steps of:
forming a slurry containing abrasive boehmite particles by
dipping particles of aluminum in heated water; and
planarizing at least one film formed on a substrate by
employing a chemical-mechanical polishing process using said
slurry,
wherein said step of forming a slurry includes adding
sodium aluminate to said heated water.

24. A polishing process according to claim 22, wherein
said heated water is about 80 °C.

25. A polishing process according to claim 22, wherein
said chemical-mechanical polishing process is performed in a
basic atmosphere.

26. A polishing process according to claim 25, wherein
said boehmite particles are suspended in a solution containing
KOH, water, and an alcohol.

27. A polishing process according to claim 22, wherein
said film is an interlayer dielectric film.